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A general target for MVPs: unsupported and unnecessary

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We recently reviewed [1] evidence for a consistent standardised estimate of minimum viable populations (MVPs) across taxa [2-4] and found that the universal MVP of 5000 adults advocated by Traill et al. [5] was unsupported by reanalyses of their data. We identified shortcomings in the original analyses and interpretations (in refs [2-4]), and found substantial uncertainty in MVP estimates, both within populations of the same species and among species. We concluded that neither data nor theory supported a generally applicable MVP.

No evidence refuting the technical problems that we identified in their original analyses was presented by Brook et al. [6]. Instead, they agreed with us that the existence of a universally-applicable MVP is illusory and that no such ‘magic number’ exists. Brook and colleagues’ clear rejection of a universal MVP is important because both popular coverage [7] of their work and many statements in their own publications had suggested otherwise. For example, Frankham et al. [8, p518] wrote that evidence against universality was simply “*...an artefact of defining it for a fixed number of years, rather than generations.*” Likewise, Traill et al. [5, p30] stated that “*The bottom line is that both evolutionary and demographic constraints on populations require sizes to be at least 5000 adult individuals*”, judging 5000 to be a “*...consensus...[and] useful benchmark*” [5, p32]. Even in their letter [6], Brook et al. assert that genetic arguments are sufficient to embrace a generalised MVP, overlooking statistical artefacts in the translation of effective size to census size and the substantive variation that characterizes these data [9, 10]. Their confidence in the merits of 5000 as an MVP conservation target is emphasized by its recent use as “*...an empirically supported threshold MVP target*” for conservation triage

[11, p000]. Given this backdrop of mixed messages, it is critically important to (re)emphasize the contingent nature of MVPs and the wide variability of MVPs among populations and species [1].

While Brook et al. [6] rejected a universally applicable MVP, they extolled the contradictory argument that a general rule of thumb remains scientifically defensible and pragmatically necessary. They asserted that, because conservation data are often lacking, decision-makers desperately need a general quantitative MVP target. We remain unconvinced that there is a 'desperate need' that justifies the use of an unsubstantiated rule-of-thumb. Conservation practitioners and policy makers don't need unsupported rules of thumb that don't survive comparisons with data; standardized MVPs did not cluster around 5000 individuals but varied over five to eight orders of magnitude [2-4]. Conservation practitioners are also quite capable of dealing with uncertainty and context-specific conservation strategies. There are ample examples from the literature that conservation practice is aware of the inherent imprecision and contingency that characterizes the discipline [12-14]. Moreover, practitioners have expressed a reluctance to embrace general rules of thumb for fear of being held strictly accountable to them when circumstances dictate otherwise.

Brook et al. question whether it is possible to conduct conservation in the absence of a general guideline for MVPs that can be applied to populations about which little is known. We believe that this is a misguided concern. MVP is only of interest when we have an estimate of population size for comparison. Supposing that it is possible to acquire a precise estimate of a population's size (*c.f.* [15]) without gaining any insights into limiting

factors and threats, how would a general guideline for MVP contribute to its conservation? Brook et al. emphasise three possible benefits of a generalised MVP. First, they suggest that, when data and resources are scarce, a generalised MVP provides a necessary alternative to Caughley's declining population paradigm [16]. Generalising MVP, they claim, is "guided by general principles that are underpinned by theory, data and models, and which integrate multiple factors (including feedbacks and synergies), treating uncertainty and assumptions explicitly and transparently." We cannot reconcile this description with the flawed analyses that led to the unsupported generality of 5000 being christened a "magic number" [7]. Brook et al.'s second purported benefit of a generalised MVP is as "a defensible tool for prioritizing conservation actions" [5, 17]. Comparing the relative merits of conservation investments among species or populations based on their population sizes, when ignorant of their threats, trends and other traits is a highly dubious enterprise [1]. Moreover, in such uncertain circumstances, a veneer of quantitative comparison is less honest than making decisions using broad categorisations of risk based on multiple characteristics, such as are embodied by IUCN's Red List [18].

A third application of generalised MVP is as a target for listing and de-listing populations of conservation concern [6]. A general rule could offer a target at which point conservation efforts could be deemed to have been successful. However, if conservation work has been on-going with any success, it seems inconceivable that those responsible could be so ignorant of the population's biology and current threats that they must remain reliant on a generalised rule based only on population size to determine when they feel confident in de-listing the population. De-listing targets might often appear low

but, in reality, such outcomes are usually the result of political exigencies trumping scientific advice (e.g. [19]). The most defensible use of a generalised MVP might, thus, be in listing decisions. Currently, 38% of evaluated species are listed as threatened [20, p15]. Raising the IUCN criterion D1 for Vulnerability (“Population size estimated to number fewer than 1000 mature individuals” [18]) by a factor of five risks translating ‘threatened’ into such a commonplace designation that it ceases to carry any weight.

Brook et al. characterised our treatment of a generalised MVP as a “...distraction of minor scientific squabbles” that, by implication, detracts from the important tasks faced by those burdened with the conservation of at-risk species. In contrast, we believe that to overlook the large variability in standardised MVPs poses serious practical problems for conservationists. Arguing for the validity of an unsupportable general MVP: (1) risks complacency when threatened populations exceed the suggested guideline; (2) risks writing populations off as lost causes that could be viable at sizes well below the guideline size (e.g. [21]); and (3) risks establishing a shaky foundation for subsequent policy decisions. In the latter case, conservation biologists would do well to heed the lessons of other scientific fields in which even minor errors of fact have proven highly damaging to much broader enterprises (e.g., [22]). Advice on general MVPs stemming from Brook and colleagues is being cited in challenges to land management. If the conservation community were to accept, without question, such a dubious principle, it would not reflect well on conservation biology as a discipline.

The conservation of species that are deemed to have an unacceptably high risk of extinction, by whatever criteria, is a difficult undertaking. The “sin” is not in demanding

thoughtful consideration of the circumstances leading to increased rarity and how conservation practice might reverse that trend. Rather, the “sin” is in implying that conservation science can compare a species’ current population size against a general threshold in order to judge its safety, whether it is worthy of conservation expenditures, or whether it should be tossed from the ark.

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